Poor Patient-Reported Outcomes following Surgical Treatment of Eaton Grade 1 Osteoarthritis of the Thumb Carpometacarpal Joint

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Abstract

Background Osteoarthritis of the thumb carpometacarpal joint (CMC-1 OA) is increasingly common with age. Conservative treatment with anti-inflammatory medication, thumb spica splinting, and steroid injection is recommended for early-stage OA, but some patients will continue to have refractory symptoms and surgery may be considered. We found it interesting to study outcomes of surgical treatment of cases with mild radiographic changes and yet symptoms severe enough to indicate surgery. The specific research question is, if there is a limit of radiographic changes, below which a poor patient-reported outcome (PRO) can be expected.

Purpose In a retrospective cohort of patients with prospectively collected PROs, we intend to study the effect of the radiographic CMC-1 OA severity on the PRO improvement and satisfaction after interposition arthroplasty.

Patients and Methods Radiographs of 347 patients, who had CMC-1 surgery, were retrospectively analyzed. Each rater independently assessed all radiographs classifying each according to the Eaton classification. All patients had surgery with CMC-1 interposition arthroplasty using three well-known techniques that all include a complete trapeziectomy. Comparison between stage 1 and stage 2–4 was done using Chi-square test and *t*-test.

Results Patients with Eaton stage 1 had a mean improvement in Quick-DASH (Quick-Disability of the Arm, Shoulder, and Hand questionnaire) scores of 14.6 points. Patients with Eaton stage 2 to 4 had a mean improvement of 25.3 points. The difference between these two groups was 10.6 points ($p = 0.009$). Only 52% of patients with Eaton stage 1 OA were satisfied. However, 76% of patients with Eaton stage 2 to 4 were satisfied ($p = 0.008$, chi-square between stage 1 and stage 2–4).

Conclusion Patients with Eaton stage 1 CMC-1 OA had poorer PROs, as compared with more advanced stages of OA, 6 months following surgical treatment with interposition arthroplasty. Based on our results, we advise against surgical treatment with interposition arthroplasty of the very mildest CMC-1 OA, regardless of the preoperative PROs.

Keywords
- thumb carpometacarpal joint
- Eaton
- classification
- radiographs
- patient-reported outcomes
- interposition arthroplasty

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Osteoarthritis (OA) of the thumb carpometacarpal joint (CMC-1) is increasingly common with age.[1–3] Conservative treatment with anti-inflammatory medication, thumb spica splinting, and steroid injection is recommended for early-stage OA, but some patients will continue to have refractory symptoms and surgery may be considered. Several different surgical techniques exist including resection arthroplasties with or without ligament reconstruction.[4,5] While these procedures were developed for end-stage OA, these same procedures may be used for refractory cases of early CMC-1 OA. A systematic review found no correlation between radiographic changes and symptom severity, and treatment recommendations and guidelines depend on the response to nonoperative treatment rather than radiographic abnormalities.[6] Since guidelines are primarily based on clinical symptoms and less on the extent of radiographic changes, we found it interesting to study outcomes of surgical treatment of cases with mild radiographic changes and yet symptoms severe enough to indicate surgery. The specific research question is, if there is a limit of radiographic changes, below which a poor patient-reported outcome (PRO) can be expected. Our hypothesis is that patients with mild CMC-1 OA will have a poor outcome following surgical treatment with trapeziectomy and tendon interposition.

Purpose

In a retrospective cohort of patients with prospectively collected PROs, we intend to study the effect of the radiographic CMC-1 OA severity on the PRO improvement and satisfaction after interposition arthroplasty.

Methods

Patients and Radiographs

Radiographs of 347 patients who had CMC-1 surgery were retrospectively analyzed in a consecutive series from 2013 to 2020. Only patients with preoperative completed PROs were included in this retrospective study. Radiographs were analyzed by two senior hand surgeons and one hand surgery fellow. All radiographic sets included a posterior–anterior projection as well as the Robert's view[7] of the CMC-1 joint. Each rater independently assessed the 347 radiographs classifying each according to the Eaton classification.[8] Consensus decisions were made on a separate occasion when one or more raters disagreed. A minimum of 4 weeks between the individual evaluation and the consensus evaluation was ensured to prevent recall bias from any of the raters (►**Table 1**). Of these, 31 patients had stage 1 OA (►**Fig. 1**).

Table 1 Baseline demographics stratified by Eaton classification stages

Eaton stage	1	2	3	4	Radiographs missing	Total
N	31	141	128	47	12	359
Age, y (mean)	54.8	61.7	63.1	67.2	60.3	62.3
Gender (M/F)	5/26	34/106	30/99	7/40	4/8	80/279
QDASH (mean, SD)	55.6 (17.2)	49.5 (14.6)	48.6 (16.7)	49.9 (13.3)	49.1 (24.4)	49.7 (13.6)
Pain (mean, SD)	3.9 (0.8)	3.7 (0.7)	3.7 (0.7)	3.6 (0.6)	3.6 (0.9)	3.7 (0.7)

Abbreviations: QDASH, Quick-Disability of the Arm, Shoulder, and Hand questionnaire; SD, standard deviation.
Note: Pain scores, 1 = no pain, 2 = mild pain, 3 = moderate pain, 4 = severe pain, 5 = extreme pain. In 12 cases radiographic material was missing.

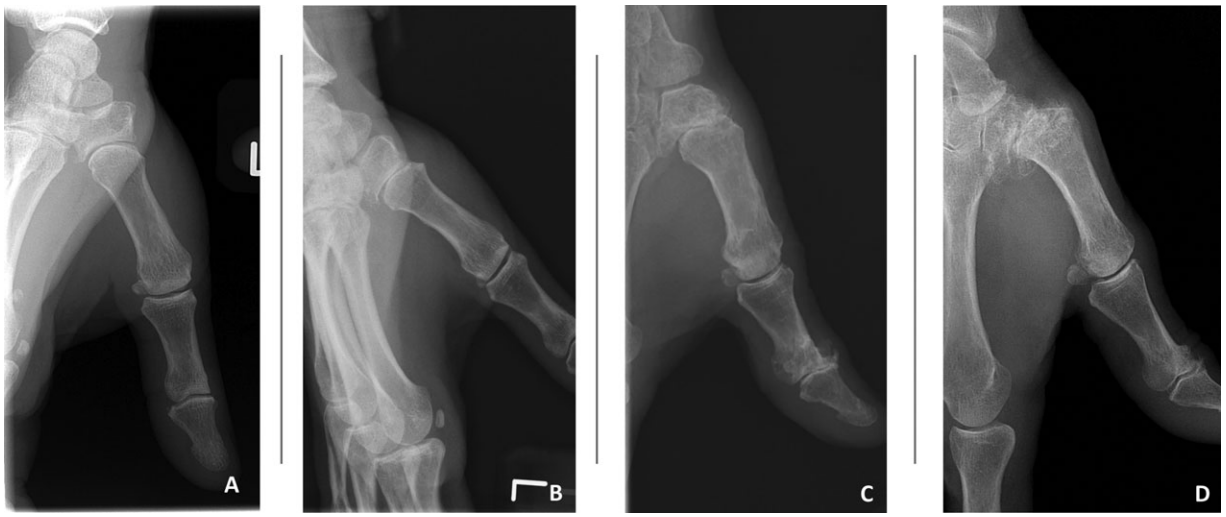

Fig. 1 Robert's view of the thumb carpometacarpal joint (CMC-1 joint). (**A**) Eaton stage 1 osteoarthritis. (**B**) Eaton stage 2 osteoarthritis. (**C**) Eaton stage 3 osteoarthritis. (**D**) Eaton stage 4 osteoarthritis.

Surgical Technique and Indication for Surgery

All patients had surgery with CMC-1 interposition arthroplasty using three well-known techniques that all include a complete trapeziectomy.[4,5,9] All senior hand surgeons had expertise of level three or four (experienced or highly experienced).[10] Surgical treatment was indicated based on the clinical examination, the patient history, and radiographic presence of CMC-1 OA, regardless of the extend of OA. Conservative treatment was insufficient in all 31 patients. Of the 31 patients with stage 1 OA, 7 had previous splinting, 12 had one or more corticosteroid injections with insufficient result, 2 had a very good result from surgery on the contralateral hand and wanted the procedure performed, 2 had an old Bennett fracture, and the rest had no specific reason other than pain.

Patient-Reported Outcomes

Patients were followed with PRO as well as a question about satisfaction. Patients were followed using our online database (Procordo, Copenhagen) and answered the PRO electronically before and 6 months following surgery. We used the validated Danish Quick-DASH (Quick-Disability of the Arm, Shoulder, and Hand) questionnaire.[11,12] The Quick-DASH score is a composite score ranging from 0 to 100, where 0 is no disability and 100 is extreme disability. Pain was evaluated from the Quick-DASH question no. 9 with the subject of arm, shoulder, or hand pain, quantified on a scale of 1 to 5, 5 being extreme pain. The patients were asked if they were satisfied with the result 6 months following surgery (yes/no).

Statistics

Parametric statistics were used given the number of patients. Comparison between stage 1 and stage 2 to 4 was done using the Chi-square test (binary outcome) test and *t*-test (continuous outcome). SPSS software v. 24 was used for statistics, and $p < 0.05$ was considered statistically significant. No Bonferroni corrections were made because the purpose of the study was defined before any statistical analysis.

Results

Patients with Eaton stage 1 OA had a preoperative Quick-DASH score of 55.6 ($n = 31$). Patients with Eaton stage 2 to 4 had a preoperative Quick-DASH score of 49.2 ($n = 316$). The difference between these two groups before surgery was 6.4 points ($p = 0.028$). Patients with Eaton stage 1 had a mean improvement in Quick-DASH scores of 14.6 points. Patients with Eaton stage 2 to 4 had a mean improvement of 25.3 points. The difference between these two groups was 10.6 points ($p = 0.009$; ►**Table 2**). Only 52% (13 of 25) patients with Eaton stage 1 OA were satisfied with the result 6 months following surgery. However, 76% (215 out of 282) of patients with Eaton stage 2 to 4 were satisfied ($p = 0.008$, chi-square between stage 1 and stage 2–4; ►**Table 3**). Pain scores improved with 1.04 points in patients with Eaton stage 1 OA and with 1.44 points in Eaton stage 2 to 4 ($p = 0.068$; ►**Table 4**).

Table 2 The improvement in QDASH scores from before surgery to 6 months following surgery

	n	QDASH, mean	95% CI	*p*[a]
Eaton stage				
Stage 1	25	14.64	7.0–22.2	**0.009**
Stage 2	123	24.67	21.0–28.3	0.845
Stage 3	118	25.50	22.0–29.0	0.437
Stage 4	41	26.76	20.8–32.0	0.486
Total	319	24.53	22.36–26.70	

Abbreviations: CI, confidence interval; QDASH, Quick Disability of the Arm, Shoulder, and Hand Questionnaire.
Note: 40 patients did not reply after surgery and are missing. In 12 cases radiographic material was missing. Bold: statistically significant.
[a]*p*-Values represent a *t*-test between the specific stage and the remaining stages (e.g. stage 1 vs. stage 2–4).

Table 3 Satisfaction 6 months following surgery

	n	Satisfied %, (y/*n*)	*p*[a]
Eaton stage			
Stage 1	25	52 (13/12)	**0.008**
Stage 2	123	71 (87/36)	0.247
Stage 3	118	80 (94/24)	0.088
Stage 4	41	83 (34/7)	0.173
Total	319	75(238/81)	

Note: Patients were asked "Are you satisfied with the result following the surgery" Yes/No. Forty patients did not reply after surgery and are missing. In 12 cases radiographic material was missing. Bold: statistically significant.
[a]*p*-Values represent a chi-square test between the specific stage and the remaining stages (e.g. stage 1 vs. stage 2–4).

Table 4 The improvement in pain scores from before surgery to 6 months following surgery

	n	Pain, mean	95% CI	*p*[a]
Eaton stage				
Stage 1	25	1.04	0.54–1.54	0.068
Stage 2	123	1.38	1.20–1.57	0.702
Stage 3	118	1.53	1.33–1.72	0.132
Stage 4	41	1.39	1.08–1.70	0.896
Total	319	1.40	1.23–1.52	

Abbreviation: CI, confidence interval.
Note: Forty patients did not reply after surgery and are missing. In 12 cases radiographic material was missing. Pain was evaluated from the QDASH questionnaire. 1 = no pain, 2 = mild pain, 3 = moderate pain, 4 = severe pain, 5 = extreme pain.
[a]*p*-Values represent a chi-square test between the specific stage and the remaining stages (e.g. stage 1 vs. stage 2–4).

Discussion

We found very poor PRO improvement and satisfaction following surgical treatment of stage 1 OA using interposition arthroplasty in 31 patients. These patients improved with a mean of 14.6 points in Quick DASH, which is well below the reported minimal important difference of 19 points.[13] The three procedures used[4,5,9] were all developed for end-stage OA and results following treatment of stage 1 OA have, to our knowledge, not been published before.

While it is tempting to argue that these patients should have never been offered interposition arthroplasty, it is worth noticing that these patients have similar or even worse preoperative PRO and pain scores as compared with patients with stage 2 to 4 OA. Other procedures do exist for early-stage OA of the CMC-1 joint. Eaton and Littler described a ligament reconstruction without trapezium excision in 1973.[14] Lane and Henley published a series of 35 patients using this technique with 67% excellent (no pain, pinch strength greater than 90% of the contralateral thumb, no instability) and 30% good (infrequent/minimal pain, pinch greater than 70%, and no instability) results 5 years following surgery.[15] Other techniques include arthroscopic treatment. In 2011 Diaconu et al showed promising short-term results following arthroscopic treatment using a poly-L-lactic acid implant in 25 patients.[16] Some years later however, medium-term results from a retrospective series of 26 patients was published with poor results and almost 50% of patients reoperated within 2 years with a complete trapeziectomy.[17]

Limitations

Previous studies have reported low interrater reliability and intrarater reproducibility when using the Eaton classification.[18–20] A systematic review from 2014 found that the Eaton classification yields moderate interrater agreement at best.[6] In our study, however, the clinical importance seems to be the distinction between OA stage I and above. This has yet to be examined.

Three different surgical techniques were used, and it is possible that differences could be found. Previous results from this database[21] found no differences between surgical techniques when comparing the improvement in Quick-DASH scores, pain scores, or satisfaction, which is in line with the current literature.[22]

Conclusion

Patients with Eaton stage 1 CMC-1 OA had very poor patient-reported outcomes 6 months following surgical treatment with interposition arthroplasty. Based on our results, we advise against surgical treatment with interposition arthroplasty of the very mildest CMC-1 OA, regardless of the preoperative patient-reported outcomes.

Authors' Contributions

R.W.J. conceived the study, did statistical analysis, drafting of manuscripts, gained approval from the Danish Patient Safety Authority. K.A.A. did manuscript revision and reviewed the radiographic material. C.H.J. did manuscript revision and reviewed the radiographic material. A. O. did manuscript revision and created the online system for radiographic evaluation. All authors reviewed and edited the manuscript and approved the final version of the manuscript.

Ethical Approval

The National Ethical Committee does not require ethical approval for reporting patient-reported outcome measures. The Danish Patient Safety Authority approved the study: 3–3013–2899/1.

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Conflict of Interest

None declared.

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